PB84-225796

Control of Industrial VOC (Volatile Organic Compound) Emissions by Catalytic Incineration. Volume 4. Catalytic Incinerator Performance at Industrial Site C-2

Radian Corp., Austin, TX

Prepared for

Industrial Environmental Research Lab.
Research Triangle Park, NC

Jul 84

U.S. Department of Commerce
National Technical Information Service
NTIS

PB84-225796

EPA-600/2-84-118d
July 1984

CONTROL OF INDUSTRIAL VOC EMISSIONS BY CATALYTIC INCINERATION
Volume 4. Catalytic Incinerator Performance at Industrial Site C-2

by

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EPA Contract 68-02-3171, Task 50

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U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-600/2-84-118d		PB84 225796

4. TITLE AND SUBTITLE	5. REPORT DATE
Control of Industrial VOC Emissions by Catalytic Incineration; Volume 4. Catalytic Incinerator Performance at Industrial Site C-2	July 1984
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
J. R. Blacksmith and J. L. Randall	83-203-001-50-31
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
Radian Corporation 3024 Pickett Road Durham, North Carolina 27705	11. CONTRACT/GRANT NO. 68-02-3171, Tasks 39 and 50
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
EPA, Office of Research and Development Industrial Environmental Research Laboratory Research Triangle Park, NC 27711	Final; 5/82 - 8/83 14. SPONSORING AGENCY CODE EPA/600/13

15. SUPPLEMENTARY NOTES IERL-RTP project officer is P. J. Chappell, Mail Drop 63, 919/541-3738.

16. ABSTRACT The report is part of a two-phase EPA effort to assess the performance, suitability, and costs of various technologies to control emissions of volatile organic compounds (VOCs). In Phase 1, information was assembled from the literature on the use and cost of using catalytic incineration for VOC control. Results included: (1) a review of current and developing catalytic incineration technology, (2) an assessment of the overall performance of catalytic incinerators, (3) a review of applications where catalytic incinerators are used, (4) a comparative analysis of catalytic incineration with other competing VOC controls, (5) an examination of available methods for emission testing catalytic incinerators, and (6) an assessment of the need for additional performance test data. Phase 2 was a test program designed to increase the catalytic incinerator performance data base. It resulted in reports documenting the performance of eight catalytic incinerators at six industrial sites. The incinerators were used to control VOC emissions from solvent evaporation processes at can coating, coil coating, magnet wire, and graphic arts printing plants. Performance was measured at several process conditions at each site. Incinerator performance was characterized in terms of destruction efficiency, outlet solvent concentration, and energy usage. Design and operating data were collected.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution Incinerators Catalysis Organic Compounds Volatility Solvents Evaporation Magnet Wire Graphic Arts Printing Equipment	Pollution Control Stationary Sources Catalytic Incineration Volatile Organic Compounds Solvent Evaporation Can Coating	13B 11F, 20C 14E 07D 07C 20M 11K

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release to Public	Unclassified	61
	20. SECURITY CLASS (This page) Unclassified	22. PRICE

EPA Form 2220-1 (9-73)

NOTICE

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ABSTRACT

The emission of volatile organic compounds (VOCs) from industrial plants significantly increases ambient levels of photochemical oxidants, ozone, and smog. Control of industrial VOC emissions, therefore, can result in substantial environmental benefits. This study was part of a comprehensive effort by EPA/IERL-RTP to assess the performance, suitability and costs of various VOC control technologies. The objectives of the EPA program were two-fold:

(1) to provide an overview of how catalytic incineration is applied to control industrial VOC emissions and to assess the overall performance, applicability, and costs as compared to alternate VOC control technologies, and

(2) to gather actual performance data through a field testing program on existing operating industrial catalytic incinerators.

The task of meeting these objectives was accomplished in two phases. In the first phase, information was assembled from the literature on the use and cost of using catalytic incineration for VOC control. This phase of the study provides results in the following areas:

- A review of current and developing catalytic incineration technology,
- an assessment of the overall performance of catalytic incinerators,
- a review of applications where catalytic incinerators are used,
- a comparative analysis of catalytic incineration with other competing VOC controls,
- an examination of the available methods for emission testing catalytic incinerators, and
- an assessment of the need for additional performance test data.

The second phase was a testing program designed to increase the catalytic incinerator performance data base. The testing program was planned so that 8 catalytic incinerators at industrial sites would be tested.

The outputs from this phase of the program consisted of a series of reports documenting the performance of 8 catalytic incinerators at 6 industrial sites. All 8 incinerators were used to control VOC emissions from solvent evaporation processes. Incinerators at can coating, coil coating, magnet wire, and graphic arts printing plants were tested. The performance measurements were made at several process conditions at each of the sites visited. Incinerator performance was characterized in terms of destruction efficiency, outlet solvent concentration, and energy usage. Incinerator design and operating data, such as operating temperature, solvent type, catalyst volume and age, were collected to document the operating conditions during the tests.

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SECTION 1

INTRODUCTION

Radian Corporation is conducting a testing program for the U.S. Environmental Protection Agency (EPA Contract No. 68-02-3171, Work Assignment 50) to evaluate the performance of catalytic incinerators that are applied to industrial processes for volatile organic compound (VOC) control. This report documents the results of the performance testing of a catalytic incinerator operating to control VOC emissions from printing line number 3 at Plant C-2, a graphic arts printing establishment. For purposes of discussion, the term VOC is used throughout this report to mean any volatile organic compound in the gas stream sampled.

Typically, the approach taken to evaluate the performance of each industrial catalytic incinerator under this program consisted of (1) developing plant-specific test plans and test methods to characterize incinerator performance, particularly with regard to destruction efficiency, (2) performing several days of comprehensive on-site testing of each incinerator, and (3) evaluating the performance data to determine destruction efficiency as a function of incinerator operating conditions. However, the test program for the Plant C-2 catalytic incinerator was terminated early when the incinerator was found to be operating considerably off-design.

The incinerator and its relationship to the printing process are discussed in Section 2. The sampling and analytical procedures used to test the Plant C-2 catalytic incinerator are briefly presented in Section 3, and the results of the abbreviated test are summarized in Section 4. Finally, all data obtained during this portion of the test program are appended.

SECTION 2

PROCESS DESCRIPTION

Plant C-2 produces graphic arts (magazines, brochures, etc.) by web offset printing. The inks used in the printing consist of pigments borne in a heavy organic solvent of C_{12} through C_{18} hydrocarbons. After the ink is applied to the paper web, the solvent is driven off in a gas-fired drying oven, leaving the pigments on the web.

In printing line number 3, the vaporized solvent is swept with 0.9 Nm^3/sec (2000 scfm) of oven exhaust gas at 127°C (260°F) to a catalytic incinerator for VOC control. The incinerator, shown in Figure 2-1, was designed by Matthey-Bishop, Inc. and was started up in 1975. The catalyst is arranged in a ceramic honeycomb configuration and has not been replaced since startup.

The incinerator is fired with natural gas at a rated flow of 0.18 Nm^3/sec (39 scfm). The gas flow rate is controlled to sustain a catalyst inlet temperature of 454°C (850°F). The incinerator does not utilize any method of heat recovery.

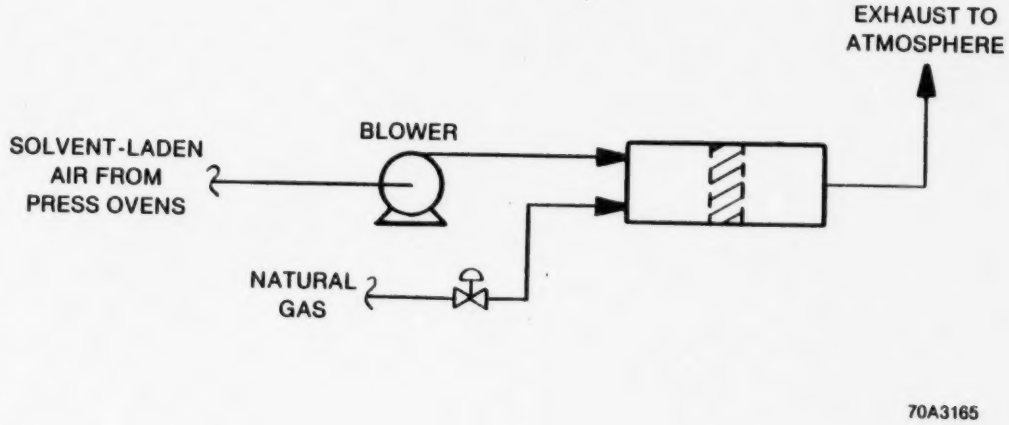

Figure 2-1. Plant C-2 Catalytic Incinerator Flow Diagram

SECTION 3

SAMPLING AND ANALYTICAL PROCEDURES

Procedures used during the performance testing of the catalytic incinerator at Plant C-2 are summarized in this section. The focus of the abbreviated test program was to characterize destruction efficiency of the incinerator. Also, carbon monoxide (CO), temperature, and flow rate measurements were made to provide additional information on incinerator performance.

3.1 TOTAL HYDROCARBON (THC) CONCENTRATION MEASUREMENT

Procedures outlined in EPA Method 25A (3-1) were used to sample and analyze the incinerator inlet and outlet gas streams for total hydrocarbon (THC) content. The sampling system shown in Figure 3-1 was used to deliver gas samples to the THC analyzers.

A Tracor Model 560 gas chromatograph (GC) was used to measure inlet solvent laden air (SLA) THC concentrations. No speciation of organics was performed; the inlet gas samples were introduced directly to the flame ionization detector (FID) for measurement. Samples were automatically injected and analyzed at approximately 3-minute intervals. The GC was calibrated with multiple propane-in-N_2 standards, and THC concentrations were expressed in parts per million as carbon (ppmc).

A Byron Model 401 Total Hydrocarbon analyzer, an FID-based instrument, was used to measure outlet THC concentrations. The analyzer, which was calibrated in a manner similar to the inlet THC analyzer, provided THC concentrations at 1-minute intervals. The Byron output data were automatically recorded, stored on disk, and reduced using an Apple II® microcomputer.

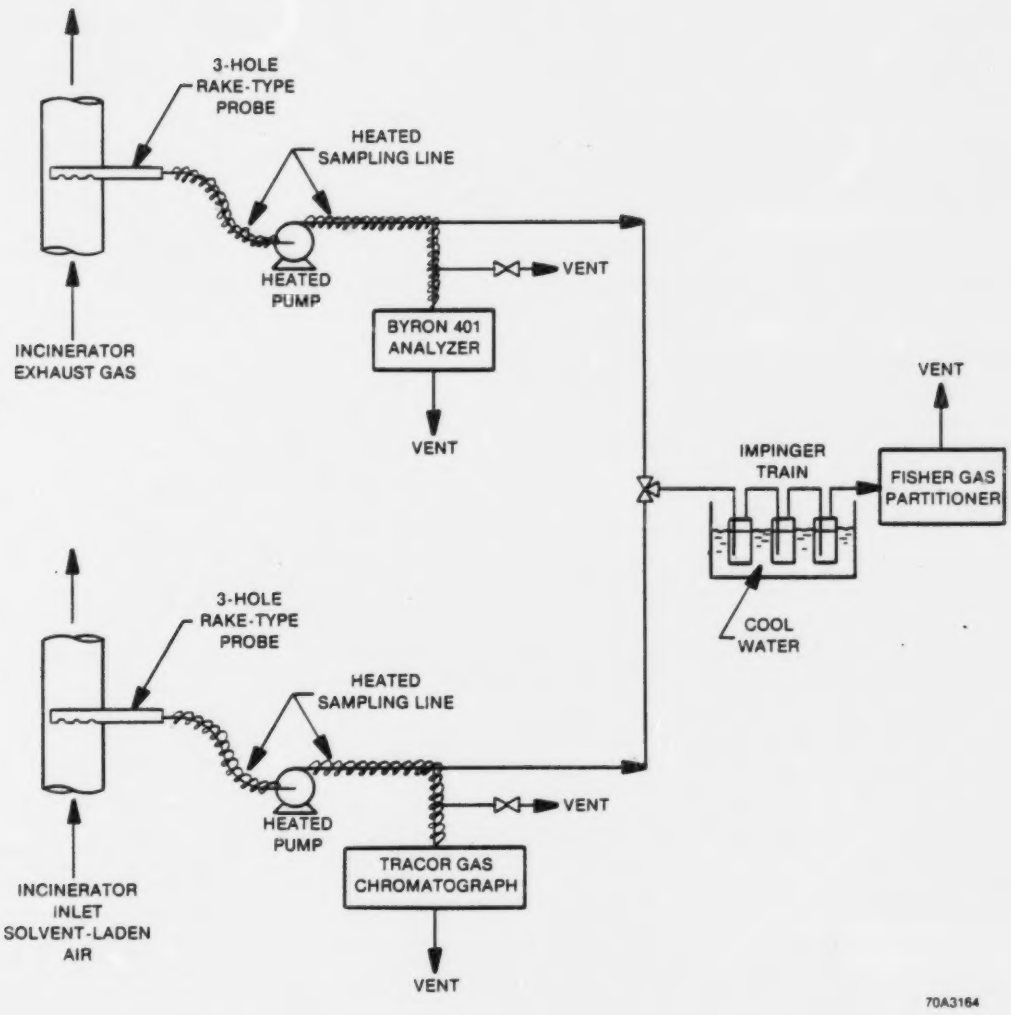

Figure 3-1. Gas Sampling System

3.2 CO CONCENTRATION MEASUREMENT

Incinerator outlet CO concentrations were periodically measured with the Byron 401 analyzer operating in the "Full Scan" mode (THC, non-methane hydrocarbons, CH_4, CO_2, and CO). Complete cycle full scan measurements were made at 12-minute intervals.

3.3 FIXED GAS ANALYSIS

A Fisher Model 1200 Gas Partitioner, a thermal conductivity detector-based instrument, was used to measure fixed gas (CO_2, O_2, and N_2) concentrations using procedures equivalent to those specified in EPA Method 3 (3-2).

3.4 TEMPERATURE MEASUREMENT

K-type thermocouples and calibrated Keithley portable temperature readouts were used to measure various system temperatures.

3.5 FLOW RATE MEASUREMENTS

The pitot tube traverse procedures outlined in EPA Methods 1 and 2 (3-3, 3-4) were used to determine the velocity and volumetric flow rates of the inlet and outlet gas streams.

3.6 REFERENCES

3-1 EPA Proposed Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," Proposed Revision to Appendix A 40 CFR, Federal Register, Volume 45, Number 194, December 17, 1980. pp. 83149-83151.

3-2 EPA Reference Method 3, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight," Appendix A to 40 CFR, Environment Reporter, Bureau of National Affairs, Washington, DC, December 5, 1980. pp. 33-36.

3-3 EPA Reference Method 1, "Sample and Velocity Traverses for Stationary Sources," Appendix A to 40 CFR, Environment Reporter, Bureau of National Affairs, Washington, DC, December 5, 1980. pp. 23-25.

3-4 EPA Reference Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," Appendix A to 40 CFR, Environment Reporter, Bureau of National Affairs, Washington, DC, December 5, 1980. pp. 25-33.

SECTION 4

RESULTS OF TESTING AND ANALYSIS

Performance testing of the catalytic incinerator at Plant C-2 was conducted from December 6 through December 9, 1982. Testing focused on a 42-hour period beginning at 6:30 P.M. on December 7 and ending at 12:30 P.M. on December 9. During that time, the incinerator was operated continuously, although the press exhausting solvent VOC's to the incinerator was in operation less than 65 percent of the time. A complete press/incinerator operating log is presented in Appendix A.

4.1 VOC SAMPLING AND ANALYSIS

During the 42-hour test period, approximately 36 hours of inlet and outlet THC (EPA Method 25A) measurements were logged. The remainder of the period was devoted to scheduled instrument calibration. The THC data are summarized in Table 4-1 and are reproduced in their entirety in Appendices B, C, and D.

As shown in the table, the incinerator's THC destruction efficiency as measured for the entire test period averaged 75.2 percent. With the press on (generating VOC's for the incinerator to destroy), the incinerator THC destruction efficiency averaged 81.2 percent, with inlet and outlet concentrations averaging 1020 and 169 ppmc, respectively. However, during times when the press was shut down, destruction efficiency averaged less than 20 percent, as inlet and outlet THC concentrations averaged 187 and 135 ppmc, respectively. Measurable THC levels were present in the incinerator inlet even when the press was shut down; these THC concentrations were attributed to the presence of residual solvent vapors in the drying oven. The relatively

TABLE 4-1. SUMMARY OF EPA METHOD 25A DATA -- PLANT C-2 CATALYTIC INCINERATOR

Press Status	Incinerator Status	Average Inlet THC Concentration, ppmc	Average Outlet THC Concentration, ppmc	Average Inlet THC Mass Rate(M_i), kgC/hr[a] (lbC/hr)	Average Outlet THC Mass Rate(M_o), kgC/hr[a] (lbC/hr)	THC Destruction Efficiency (DE), %[b]
On	On	1020	169	1.70 (3.74)	0.319 (0.702)	81.2
Off	On	187	135	0.312 (0.687)	0.255 (0.561)	18.3
Weighted Average[c]		714	157	1.19 (2.62)	0.295 (0.650)	75.2

[a] $M = \left(\frac{(C) \text{ mole C}}{\text{mole gas}}\right)\left(\frac{12 \text{ lb C}}{\text{mole C}}\right)\left(\frac{\text{mole gas}}{378 \text{ ft}^3}\right)\left(\frac{(Q) \text{ ft}^3}{\text{min}}\right)\left(\frac{60 \text{ min}}{\text{hr}}\right)\left(\frac{0.454 \text{ kg}}{\text{lb}}\right)$, where C = THC concentration, ppmc
Q = gas flow rate, scfm (wet).

[b] $DE = \frac{M_i - M_o}{M_i} \times 100\%$.

[c] Press on 63.3% of time; press off 36.7% of time (from Appendix A).

high THC levels in the incinerator exhaust gas when the press was off apparently resulted from the catalyst's inability to promote effective oxidation of relatively dilute THC concentrations.

A portion of the summary data from Table 4-1 is expanded in Table 4-2 to show in more detail the effect of operating characteristics on THC destruction efficiency. Table 4-2 shows that, for the period shown, the destruction efficiency was constant at about 81 percent when the press was on, regardless of inlet THC concentration. However, when the press was off, the destruction efficiency decreased to 61 percent.

The relatively low THC destruction efficiency during all periods of operation was related to the catalyst temperature trends presented in the table. The catalyst outlet temperature consistently averaged about 56°C (100°F) lower than the catalyst inlet temperature, suggesting that VOC oxidation (heat release) across the catalyst bed was minimal (the temperature readings were confirmed by multiple readings using several different thermocouples and readout devices). Also, a high pressure drop of 0.13kPa (10 in. H_2O) across the bed was observed. Apparently the catalyst was fouled and unable to promote VOC oxidation, a conclusion supported by the system vendor (4-1).

Information received prior to the testing gave no indication that the incinerator was not operating according to design specifications. Previous test data had indicated a THC destruction efficiency of about 98 percent. Also, preliminary plant information had indicated that the incinerator had logged only about 2000 hours of service since startup in 1975. This estimate was later determined to be considerably in error by plant personnel. Finally, the absence of catalyst inlet and outlet temperature monitors allowed the atypical temperature trends to go undetected by operating personnel.

The plant's operation of the incinerator with a 454°C (850°F) inlet temperature setpoint may have contributed to the deactivation of the catalyst.

TABLE 4-2. RELATIONSHIP OF THC DESTRUCTION EFFICIENCY TO OPERATING CONDITIONS--EXAMPLE RESULTS

Date	Time[a]	Press Status	System Status[b]	SLA	Temperatures, °C Catalyst Inlet	Catalyst Outlet	Stack	THC Concentrations, ppmc Inlet	Outlet	Destruction Efficiency, %[c]
12/8/82	1918-1956	On	Unsteady	--[d]	489	423	386	895	150	81.0
	1957-2021	On	Steady	--[d]	486	426	392	1250	201	81.8
	2022-2030	Off	Unsteady	--[d]	486	413	384	402	138	61.1
	2031-2034	On	Unsteady	--[d]	486	426	389	1160	207	79.8
	2035-2045	On	Steady	102	497	438	392	1260	211	81.1

[a]Incinerator was on during entire test period.

[b]Reflects variability in press/incinerator operation.

[c]Calculated as shown in Table 4-1.

[d]Not measured.

Previous operation of the incinerator with high inlet THC loadings may have caused VOC oxidation rates high enough to produce catalyst temperatures to routinely exceed 540°C (1000°F). Operation under these conditions for prolonged periods would tend to sinter (deactivate) the catalyst.

The data presented in Table 4-2 is presented graphically in Figure 4-1. The inlet and outlet THC concentrations are shown to increase slowly as the drying oven warmed up (increasing solvent evaporation) after a prolonged shutdown. "Dips" and "spikes" in the incinerator inlet THC concentrations, corresponding to brief shutdowns and startups of the press, are also observed in the outlet THC concentration profiles.

4.2 CO SAMPLING AND ANALYSIS

CO analysis of the incinerator exhaust gas was performed for a two-hour period. CO concentrations averaged 89 ppmc with the press intermittently off and on. With the press running and exhausting VOC's to the incinerator, the outlet CO concentrations averaged 106 ppmc. In general, outlet CO concentrations were in direct proportion to outlet THC concentrations.

4.3 REFERENCES

4-1 Personal communication with E. Smith, Johnson Matthey, Inc., February 8, 1983.

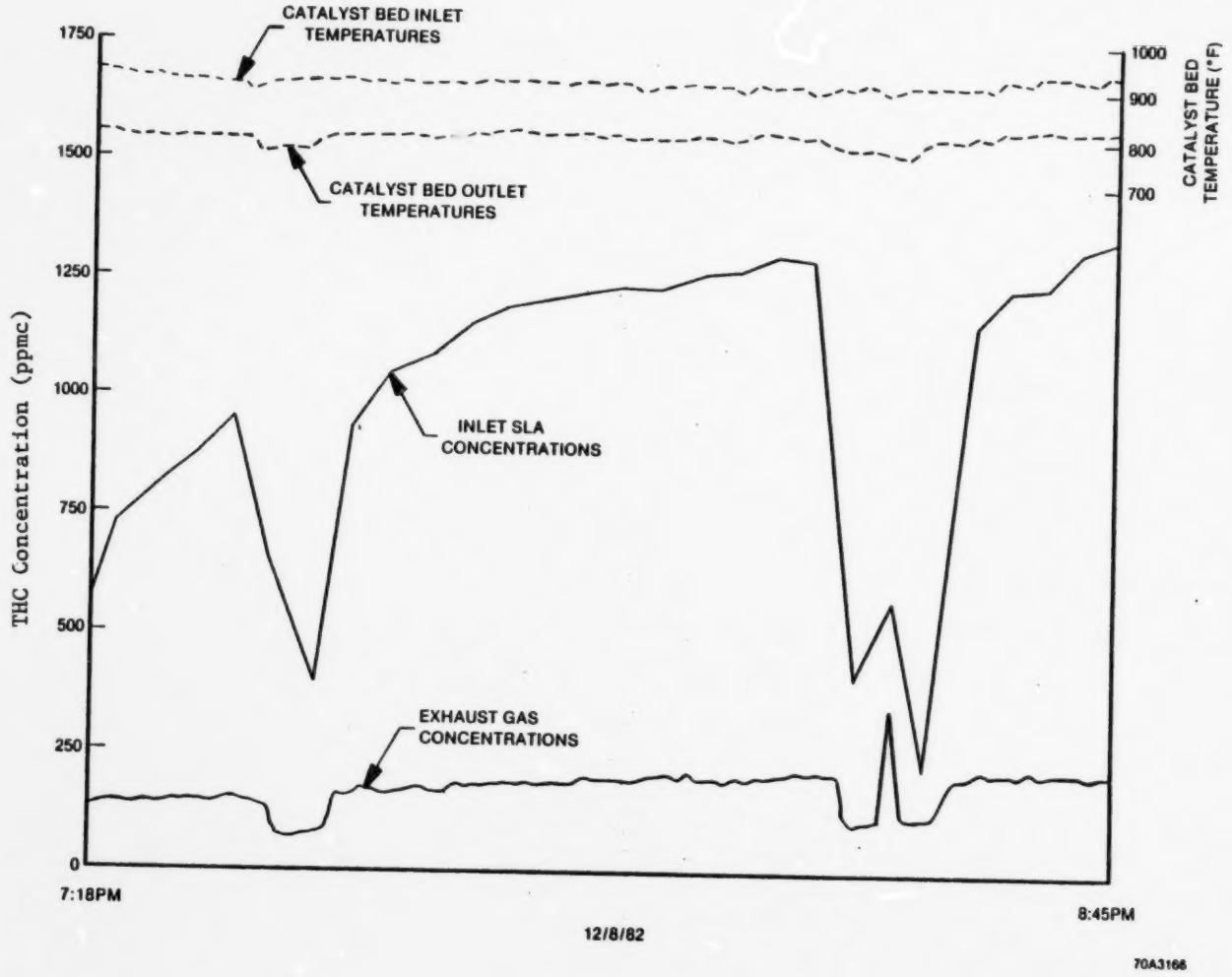

Figure 4-1. Typical Catalyst Bed Temperature and THC Concentration Profiles

APPENDIX A

OPERATING LOG AT PLANT C-2

Date	Time (Military)	Incinerator Status	Press Status	THC Analysis
120782	1826-1836	On	Off	Inlet only (THC)
	1837-1848			Outlet only (THC)
	1849-2359			Inlet (THC), outlet (THC)
120882	0000-0014			Inlet (THC), outlet (THC)
	0015-0024			Outlet only (THC)
	0025-0041			None
	0042-0608		On	Inlet (THC), outlet (THC)
	0609-1204		Varied	None (calibration)
	1205-1223			Inlet only (THC)
	1224-1231			Outlet only (THC)
	1232-1304		On	Inlet (THC), outlet (THC)
	1305-1315		Off	
	1316-1427		On	
	1428-1530		Off	
	1531-1545		On	
	1546-1552		Off	
	1553-1636		On	
	1637-1639		Off	
	1640-1728		On	
	1729-1739		Off	
	1740-1804		On	
	1805-1917		Off	
	1918-2021		On	
	2022-2030		Off	
	2031-2109		On	
	2110-2112		Off	
	2113-2156		On	
	2157-2249		Off	
	2250-2320		On	
	2321-2359		Off	
120982	0000-0101		Off	
	0102-0330		On	
	0331-0346		Off	
	0347-0401		On	
	0402-0404		Off	
	0405		On	
	0406-0408		Off	
	0409-0457		On	
	0458-0501		Off	

APPENDIX A

OPERATING LOG AT PLANT C-2
(continued)

Date	Time (Military)	Incinerator Status	Press Status	THC Analysis
120982	0502-0747	On	On	Inlet (THC), outlet (THC)
	0748-0757	↓	Off	↓
	0758-0927		On	
	0928-0934		Off	
	0935-1043		Varied	None (calibration)
	1044-1208		On	Inlet (THC), outlet (Full Scan)
	1209-1222		Off	↓
	1223-1239		On	
	1240-1256		On	Outlet only (Full Scan)

APPENDIX B

INLET THC SAMPLING DATA
(TRACOR THC DATA)

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 810.06

Date 120782

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
18:26	126		
18:30	126		
18:33	128		
18:36	119		

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 810.06

Date 120782

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
1849	125	1955	125
1852	128	1958	128
1856	123	2001	115
1859	545	2004	120
1902	136	2008	120
1905	135	2011	117
1909	130	2014	119
1912	130	2018	119
1915	131	2021	124
1919	134	2024	121
1922	134	2027	111
1925	128	2031	115
1928	127	2034	125
1932	185	2037	121
1935	148	2040	126
1938	261	2044	125
1941	173	2047	125
1945	132	2050	125
1948	126	2054	127
1951	125	2057	123

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 810.06

Date 120782

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
2100	120	2206	590
2103	127	2209	105
2107	218	2212	113
2110	216	2216	114
2113	122	2219	114
2117	120	2222	111
2120	125	2225	113
2123	119	2229	110
2126	120	2232	112
2130	117	2235	110
2133	116	2238	109
2136	112	2243	107
2139	111	2245	106
2143	111	2248	106
2146	104	2252	107
2149	111	2255	106
2153	177	2258	104
2156	471	2301	105
2159	118	2305	103
2202	104	2308	103

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 810.06

Date 120782-120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
2311	100		
2315	106		
2318	104	0040	149
2321	103	0044	184
2324	103	0047	200
2328	102	0050	239
2331	99	0054	274
2334	98	0057	314
2338	89	0100	124
2341	93	0103	486
2344	93	0107	55
2347	103	0110	59
2351	112	0113	284
2354	113	0117	320
2357	111		
0000	80		
0003	73	0123	379
0007	75	0126	368
0010	83	0130	384
0014	81	0133	392

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 810.06

Date 120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
0136	393	0242	281
0140	400	0245	403
0143	407	0248	431
0146	404	0252	467
0149	396	0255	482
0153	417	0258	497
0156	396	0302	526
0159	436	0305	607
0202	460	0308	552
0206	466	0311	583
0209	460	0315	604
0212	511	0318	483
0216	533	0321	395
0219	558	0324	294
0222	461	0328	257
0225	123	0331	137
0229	173	0334	370
0232	130	0338	480
0235	78	0341	524
0238	147	0344	569

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 810.06

Date 120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
0347	581	0453	729
0351	669	0456	729
0354	617	0500	736
0357	630	0503	737
0400	653	0506	737
0404	652	0509	736
0407	736	0513	741
0410	668	0516	742
0414	675	0519	743
0417	682	0522	745
0420	687	0526	807
0424	693	0529	744
0427	691	0532	475
0430	718	0536	403
0433	698	0539	392
0437	707	0543	401
0440	729	0545	447
0443	726	0549	435
0446	763	0552	425
0450	735	0555	415

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 810.06

Date 120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
0558	395		
0602	365		
0605	338		
0608	319		

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120882

Operator RFE

Sampling Location OUTLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
1204	100		
1208	103		
1211	73		
1214	66		
1218	67		
1221	77		
1224	106		
1227	83		
1231	88		

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
1234	165	1336	1002
1237	450	1340	1035
1241	592	1343	1078
1244	562	1346	1084
1247	780	1349	1071
1250	762	1353	1080
1254	810	1356	1092
1257	817	1359	1079
1300	937	1402	1116
1304	983	1406	1106
1307	171	1409	1105
1310	119	1412	1103
		1416	1103
1313	110	1419	1154
1317	832	1422	260
1320	902	1425	728
1323	934	1429	155
1326	955	1432	228
1330	971	1435	143
1333	981	1438	131

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
1442	128	1544	429
1445	131	1547	304
1448	125	1551	189
1452	122	1554	894
1455	184	1557	967
1458	109	1601	1010
1502	109	1604	1015
1505	111	1607	1037
1508	176	1610	1009
1511	110	1614	984
		1617	1020
1515	107		
1518	110	1620	1038
1521	111	1624	1066
1524	109	1627	1072
1528	157	1630	1060
1531	779	1633	1058
1534	866	1637	250
1538	912	1640	442
1541	959	1643	933

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
1646	996	1752	1143
1650	1010	1755	1184
1653	1037	1759	1236
1656	1163	1802	1222
1700	1027	1805	421
1703	1029	1808	263
1706	1027	1812	232
1709	1020	1815	258
1713	977	1818	221
1716	1073	1822	217
1719	1014	1825	214
1723	1004	1828	211
1726	1041	1832	241
1729	703	1835	190
1732	250	1838	229
1736	218	1841	192
1739	317	1844	187
1742	1054	1848	207
1746	1050	1851	174
1749	1075	1854	207

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
1858	176	2003	1236
1901	168	2006	1233
1904	160	2010	1256
1907	181	2013	1265
1911	178	2016	1300
1914	149	2019	1297
1917	516	2023	408
1920	726	2026	572
1924	823	2029	226
1927	880	2033	1163
1930	956	2035	1233
1933	654	2039	1245
1937	400	2043	1316
1940	929	2046	1349
1943	1045		
1947	1093	2049	1279
1950	1150	2052	1257
1953	1186	2056	1355
1957	1207	2059	1286
2000	1218	2102	1294

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = RFE

Date 120882

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
2106	1312	2211	175
2109	1300	2214	231
2112	289	2218	178
2115	2239	2221	172
2119	1184	2224	170
2122	1244	2227	168
2125	2178	2231	166
2128	1305	2234	166
2132	1318	2237	175
2135	1325	2240	164
2138	1319	2244	202
2142	1418	2248	242
2145	1389	2250	819
2148	1351	2254	976
2151	1348	2257	1093
2155	1341	2300	1143
2158	331	2304	1214
2201	185	2307	1238
2204	178	2310	1256
2208	185	2313	1328

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120882-120982

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
2317	1351	0022	284
2320	1347	0025	260
2323	403	0029	230
2326	512	0032	227
2330	253	0035	228
2333	265	0038	233
2336	274	0042	232
2339	246	0045	226
2343	243	0048	230
2346	242	0052	229
2349	292	0055	225
2353	237	0058	225
2356	244	0101	533
2359	232	0105	904
0002	235	0108	1014
0006	257	0111	1083
0009	232	0115	1159
0012	230	0118	1276
0016	245	0121	1351
0019	238	0124	1294

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120982

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
0128	1299	0234	1330
0131	1308	0237	1320
0134	1308	0240	1320
0138	1328	0244	1320
0141	1327	0247	1310
0144	1303	0250	1310
0147	1548	0254	1320
0151	1215	0257	1320
0154	1335	0300	1340
0157	1319	0304	1340
0200	1298	0307	1340
0204	1374	0310	2320
0207	1308	0314	1370
0210	1315	0318	1340
0214	1317	0320	1330
0217	1290	0324	1340
0220	1290	0327	1340
0224	1710	0330	1340
0227	1320	0334	340
0230	1310	0337	270

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120982

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
0340	1030	0447	1220
0344	240	0450	1220
0347	240	0454	1240
0350	1050	0457	1410
0354	1150	0500	190
0357	1210	0504	1150
0400	1240	0507	1200
0404	220	0510	1200
0407	1100	0514	1220
0410	520	0517	1240
0414	890	0520	1250
0417	1120	0524	1250
0420	1160	0527	1300
0424	1170	0530	1270
0427	1200	0534	1290
0430	1210	0537	1280
0434	1210	0540	1280
0438	1230	0544	1270
0440	1210	0547	1240
0444	1220	0550	1200

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120982

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
0554	1210	0700	1210
0557	1670	0704	1220
0600	1220	0707	2330
0604	1200	0710	1230
0607	1220	0714	1240
0610	1220	0717	1260
0614	1200	0720	1250
0617	1170	0724	1250
0620	1170	0727	1260
0624	1180	0730	1250
0627	1180	0734	1250
0630	1170	0737	1300
0634	1180	0740	1320
0637	1180	0744	1520
0640	1190	0747	1310
0644	1200	0750	210
0647	1210	0754	630
0650	1210	0757	190
0654	1210	0800	1240
0657	1210	0804	1310

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120982

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
0807	1310	0914	1300
0810	1310	0917	1240
0814	1340	0920	1240
0817	1390	0924	1200
0820	1390	0927	1180
0824	1400		
0827	1410	0929	371
0830	1410	0932	213
0834	1370	0935	217
0837	1340	0939	230
0840	1390	0942	243
0844	1390	0946	228
0847	1390	0949	232
0850	1360	0952	235
0854	1320	0955	238
0857	1270	0959	240
0900	1290	1002	259
0904	1420	1005	345
0907	1270	1009	566
0910	1280	1012	465

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120982

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
1015	607	1114	1214
1018	663	1117	1229
1022	662	1121	1293
1025	685	1124	1299
1028	754	1128	1320
1032	761	1131	1369
1035	934	1134	1395
1038	992	1137	1367
		1140	1458
1041	1009	1144	1341
1045	1046	1147	1335
1048	1058	1150	1496
		1154	1670
1051	1086	1157	1661
1055	1105		
1058	1118	1200	1627
1101	1168	1203	1610
1104	1326	1207	1638
1108	1184	1210	224
1111	1197	1213	198

TRACOR THC ANALYSIS

Plant ID C-2

Incinerator Type: Thermal _____ Catalytic X

Sample Loop Size: 1.0 ml

Attenuation RF = 648.0

Date 120982

Operator RFE

Sampling Location INLET

Clock Time	THC (ppmc)	Clock Time	THC (ppmc)
1216	212		
1220	185		
1223	1302		
1226	1417		
1230	1524		
1233	1556		
1236	1523		
1239	1551		

APPENDIX C

OUTLET THC SAMPLING DATA
(BYRON 401 THC DATA)

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CATALYTIC INCINERATOR PROGRAM PLANT NO 2 ATTN=500 MULT=4.970
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 12/07 18:49

18:49	210	197	203	199	209	199	199	201	199	212
18:59	331	210	199	193	205	191	193	199	197	195
19:09	199	193	193	195	205	203	197	187	203	205
19:19	195	195	191	195	193	187	199	189	189	193

AVERAGE CONC = 201.0 PPM AS C1 FOR 40 MINUTES

19:31	216	193	207	207	205	138	146	230	197	378
19:41	207	216	154	162	158	166	162	158	162	162
19:51	162	158	154	168	171	181	232	337	407	476

AVERAGE CONC = 208.8 PPM AS C1 FOR 30 MINUTES

20:10	485	166	171	171	158	166	162	158	158	158
20:20	158	166	164	162	175	154	156	156	158	162
20:30	158	164	162	177	171	171	177	181	181	175
20:40	187	171	168	181	175	179	185	179	185	195
20:50	189	189	191	193	195	189	191	187	179	171
21:00	185	187	185	187	185	199	195	191	205	187
21:10	195	179	187	187	181	191	185	193	179	195
21:20	187	179	171	179	181	187	187	171	181	189
21:30	175	181	189	189	171	175	171	171	171	168
21:40	177	179	177	175	175	140	133	129	140	136
21:50	142	136	142	210	148	179				

AVERAGE CONC = 177.6 PPM AS C1 FOR 106 MINUTES

21:57	296	164	148	148	144	154	150	168	205	199
22:07	125	125	125	133	171	162	166	156	158	162
22:17	154	164	158	162	158	162	164	162	168	156
22:27	156	158	158	158	164	164	168	156	166	164
22:37	168	164	158	164	158	164	156	158	166	162
22:47	156	162	156	158	158	166	164	162	168	164
22:57	166	156	166	168	158	164	162	164	158	162
23:07	164	156	156	158	156	158	162	166	162	156
23:17	158	154	164	158	158	158	150	154	156	150
23:27	158	158	150	148	164	150	156	134	107	105
23:37	115	119	119	133	127	129	133	127	121	125
23:47	129	138	140	154	166	168	195	263	339	425
23:57	470	485	224							

AVERAGE CONC = 166.1 PPM AS C1 FOR 123 MINUTES

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CATALYTIC INCINERATOR PROGRAM PLANT NO 2 WITN=500 MULT=4.970
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 12/08 00:00

00:00	226	220	216	230	222	230	232	212	224	220
00:10	216	212	199	212	220	207	212	216	214	212
00:20	210	209	220	201	216	207	175	201	444	314
00:46	45	57	68	68	78	70	84	78	78	78
00:56	80	80	80	80	84	88	37	175	187	68
01:06	55	39	43	37	43	47	62	74	66	68
01:16	76	70	78	88	80	84	90	90	97	92
01:26	86	90	90	94	111	101	97	95	95	101
01:36	95	101	94	95	95	95	105	101	103	97
01:46	101	94	97	101	97	111	115	107	107	115
01:56	97	94	95	95	101	97	97	97	107	103
02:06	105	97	88	90	92	101	105	94	111	97
02:16	107	97	107	107	117	115	107	51	209	232
02:26	101	49	43	49	41	41	41	47	51	51
02:36	55	51	57	51	66	86	97	94	94	95
02:46	101	101	101	105	101	97	105	97	101	97
02:56	105	103	111	97	101	111	111	105	111	103
03:06	111	107	107	101	105	107	119	117	119	111
03:16	119	119	115	43	238	133	70	47	39	39
03:26	43	51	49	49	43	47	49	51	66	103
03:36	119	111	111	111	119	115	111	113	125	119
03:46	121	115	117	121	125	117	117	125	125	119
03:56	119	117	121	173	129	125	144	133	125	127
04:06	125	129	119	127	125	127	129	127	127	125
04:16	125	125	133	125	121	125	121	125	125	125
04:26	125	134	251	259	140	125	125	125	125	121
04:36	125	133	129	127	133	129	127	133	129	136
04:46	133	150	146	142	133	127	133	134	134	133
04:56	133	133	127	129	133	125	134	133	129	133
05:06	129	133	138	138	133	136	136	133	136	129
05:16	133	134	136	133	138	140	136	133	136	134
05:26	134	129	129	140	134	60	49	53	51	43
05:36	43	47	45	47	33	33	29	31	21	18
05:46	19	16	18	18	16	18	19	19	18	19
05:56	29	21	21	19	29	19	27	18	25	18
06:06	16	14	16	18						

AVERAGE CONC = 107.3 PPM AS C1 FOR 354 MINUTES

12:37	105	76	91	97	93	93	95	91	86	93
12:47	101	109	105	115	111	119	111	117	115	124
12:57	111	111	126	132	138	142	138	136	53	45
13:07	51	45	47	53	51	51	49	49	88	124
13:17	136	128	140	136	132	140	136	134	142	136
13:27	140	142	142	144	146	142	154	142	144	142
13:37	140	144	148	148	154	150	156	158	146	154
13:47	161	163	161	158	163	161	161	161	158	158
13:57	161	165	163	163	159	156	161	158	161	159
14:07	158	161	167	159	171	181	171	169	175	171
14:17	165	181	171	175	181	136	72	88	204	266
14:27	202	95	74	70	70	76	72	60	68	72
14:37	70	68	70	80	95	126	154	171	194	206

AVERAGE CONC = 128.5 PPM AS C1 FOR 130 MINUTES

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CATALYTIC INCINERATOR PROGRAM PLANT NO 2 ATTN=500 MULT=4.960
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 12/08 14:47

14:47	212	206	202	206	216	206	206	210	206	208
14:57	187	191	204	202	196	204	196	189	193	196
15:07	210	191	194	206	204	212	206	208	196	194
15:17	196	204	193	194	194	206	194	206	198	204
15:27	233	233	206	210	124	138	144	144	142	140
15:37	146	156	154	150	154	150	156	154	76	62
15:47	58	68	70	72	68	68	146	148	158	161
15:57	158	154	158	158	158	156	161	169	158	162
16:07	163	171	156	158	156	158	156	156	148	156
16:17	158	158	161	158	161	167	165	158	171	161
16:27	161	158	161	159	161	161	158	156	165	161
16:37	74	68	68	230	124	82	136	161	167	158
16:47	158	158	161	154	158	158	159	158	162	161
16:57	268	167	165	161	163	169	165	165	167	158
17:07	158	158	163	163	158	156	154	150	152	146
17:17	148	154	154	156	144	156	154	163	171	161
17:27	158	84	84	233	126	93	148	101	101	93
17:37	74	88	74	163	175	177	177	181	177	179
17:47	175	179	171	181	187	194	194	194	194	194
17:57	191	194	191	196	194	196	194	119	167	230
18:07	144	115	109	95	103	101	95	105	109	101
18:17	101	101	97	101	101	105	97	111	103	101
18:27	115	132	163	198	208	230	237	253	241	253
18:37	251	237	247	247	243	243	237	253	239	253
18:47	230	239	239	233	241	231	231	233	237	243
18:57	239	233	253	247	241	230	224	239	237	243
19:07	241	230	239	226	230	226	230	222	230	226
19:17	222	126	136	140	142	140	146	138	148	148
19:27	146	146	148	154	148	144	124	76	72	76
19:37	80	89	163	161	177	171	165	171	175	181
19:47	169	171	185	179	189	185	189	185	189	185
19:57	185	193	187	202	196	194	198	193	200	206
20:07	208	198	208	194	200	194	204	200	204	208
20:17	208	220	206	214	212	134	111	109	117	300
20:27	124	115	115	119	193	208	206	222	212	212
20:37	208	220	210	210	212	208	206	208	210	212
20:47	216	208	212	212	208	212	208	214	206	216
20:57	212	206	208	208	216	212	212	216	210	214
21:07	210	206	206	187	121	113	171	371	191	282
21:17	204	204	202	200	204	194	204	206	204	196
21:27	208	208	198	198	214	204	198	204	210	198
21:37	196	204	212	216	216	208	206	216	202	210
21:47	212	206	204	194	193	196	191	191	185	185
21:57	107	70	68	70	68	66	66	66	72	74
22:07	78	76	80	78	78	76	78	78	86	91
22:17	101	121	148	167	196	196	231	224	233	237
22:27	249	241	230	233	230	230	230	233	233	241
22:37	241	230	239	230	230	237	247	237	241	266
22:47	263	247	243	144	156	158	163	171	181	177
22:57	173	179	185	185	185	189	191	189	189	189
23:07	187	181	191	191	181	187	204	194	204	198
23:17	198	206	206	196	198	111	111	117	105	111
23:27	181	208	126	115	138	134	124	124	111	132
23:37	111	117	117	119	119	115	117	119	111	115
23:47	117	121	117	124	132	132	150	179	220	239
23:57	266	266	284							

AVERAGE CONC = 174.7 PPM AS C1 FOR 553 MINUTES

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CATALYTIC INCINERATOR PROGRAM PLANT NO 2 ATTN=500 MULT=4.960
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 12 09 00:00

00:00	274	282	280	274	276	268	286	284	268	276
00:10	270	280	274	284	288	282	286	288	274	274
00:20	276	276	282	278	268	282	286	278	276	276
00:30	276	276	276	276	280	274	278	278	286	284
00:40	284	270	268	286	282	276	268	270	286	280
00:50	274	274	286	280	270	268	276	280	280	276
01:00	270	251	181	165	171	179	177	179	185	181
01:10	191	185	194	191	194	198	189	191	202	198
01:20	206	204	204	204	210	208	198	208	212	208
01:30	212	220	212	220	216	220	222	220	216	216
01:40	212	222	216	216	224	220	224	220	286	230
01:50	220	226	222	224	220	214	226	222	230	222
02:00	226	220	226	216	212	222	224	216	230	218
02:10	220	220	222	220	228	216	224	233	224	222
02:20	222	224	233	226	230	231	231	268	253	233
02:30	237	230	233	230	230	231	226	231	226	233
02:40	226	231	226	230	230	230	226	231	226	226
02:50	228	230	230	230	230	233	233	237	230	230
03:00	230	239	233	241	231	237	231	233	233	237
03:10	233	239								

AVERAGE CONC = 238.3 PPM AS C1 FOR 192 MINUTES

03:13	397	276	243	233	241	241	237	231	237	241
03:23	241	233	239	247	241	233	243	237	243	239
03:33	241	241	231	233	226	230	146	134	344	163
03:43	257	150	126	124	124	132	126	124	136	193
03:53	196	204	191	194	194	194	198	194	196	202
04:03	204	142	101	103	97	259	179	204	134	121
04:13	105	111	165	163	167	179	179	171	171	175
04:23	177	181	179	173	181	181	173	177	171	181
04:33	171	169	171	171	171	175	179	175	167	171
04:43	171	167	171	177	177	173	171	171	177	179
04:53	167	177	105	78	370	249	91	93	95	167
05:03	163	173	165	161	171	171	167	179	169	165
05:13	167	179	179	171	165	165	175	169	165	165
05:23	167	167	171	177	171	175	167	171	167	181
05:33	181	171	175	179	165	167	177	175	179	163
05:43	163	165	173	163	161	159	152	150	154	154
05:53	148	150	156							

AVERAGE CONC = 180.7 PPM AS C1 FOR 163 MINUTES

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CATALYTIC INCINERATOR PROGRAM PLANT NO 2 ATTN=500 MULT=4.960
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 12/09 05:57

05:57	371	208	158	144	154	150	154	142	154	150
06:07	150	152	150	154	144	142	146	144	146	142
06:17	142	140	146	138	138	140	142	146	142	140
06:27	138	136	134	169	138	136	136	148	130	140
06:37	138	144	148	142	146	146	150	154	144	144
06:47	154	156	154	146	158	163	158	165	161	163
06:57	158	158	161	159	158	158	163	171	161	303
07:07	253	177	167	165	171	165	163	167	171	171
07:17	171	171	171	175	175	169	171	171	167	163
07:27	171	177	167	171	175	169	171	177	189	185
07:37	191	189	191	193	187	233	210	196	198	208
07:47	126	101	93	224	158	119	101	105	107	196
07:57	194	208	196	204	206	206	222	214	226	224
08:07	226	216	226	224	224	237	241	239	257	253
08:17	241	245	243	261	253	261	263	257	261	259
08:27	253	257	243	253	243	257	261	257	263	263
08:37	261	266	261	266	274	265	266	274	276	276
08:47	263	268	245	239	224	210	202	206	208	200
08:57	210	208	204	336	220	220	222	210	216	216
09:07	210	212	212	208	210	208	206	204	202	193
09:17	198	204	193	191	189	189	196	194	191	130

AVERAGE CONC = 190.8 PPM AS C1 FOR 210 MINUTES

09:28	91	200	154	93	101	105	107	105	117

AVERAGE CONC = 119.2 PPM AS C1 FOR 9 MINUTES

APPENDIX D

OUTLET THC/CO/CO_2 SAMPLING
(BRYON 401 FULL SCAN DATA)

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```
CATALYTIC INCINERATOR PROGRAM          PLANT NO 2          ATTN=500 MULT=4.960
 THC CONCENTRATIONS AS C1 IN  OUTLET  STARTING AT 12/09 11:08
-------------------------------------------------------------------------------

11:08      233    231    239    261    266    307    154     95    249    261

AVERAGE CONC = 229.6 PPM AS C1 FOR  120 MINUTES
-------------------------------------------------------------------------------

CATALYTIC INCINERATOR PROGRAM          PLANT NO 2          ATTN=200 MULT=2.092
NMHC CONCENTRATIONS AS C1 IN  OUTLET  STARTING AT 12/09 11:08
-------------------------------------------------------------------------------

11:08       89     89    103    106    107    124     28     45    136    118

AVERAGE CONC = 94.47 PPM AS C1 FOR  120 MINUTES
-------------------------------------------------------------------------------

CATALYTIC INCINERATOR PROGRAM          PLANT NO 2          ATTN=200 MULT=1.765
  CO CONCENTRATIONS AS C1 IN  OUTLET  STARTING AT 12/09 11:08
-------------------------------------------------------------------------------

11:08       84     89     96    106    101    116     26     17    127    129

AVERAGE CONC = 89.04 PPM AS C1 FOR  120 MINUTES
-------------------------------------------------------------------------------

CATALYTIC INCINERATOR PROGRAM          PLANT NO 2          ATTN=500 MULT=5.314
 CH4 CONCENTRATIONS AS C1 IN  OUTLET  STARTING AT 12/09 11:08
-------------------------------------------------------------------------------

11:08       42     44     40     46     38     38     21     27     27     21

AVERAGE CONC = 34.16 PPM AS C1 FOR  120 MINUTES
-------------------------------------------------------------------------------

CATALYTIC INCINERATOR PROGRAM          PLANT NO 2          ATTN=20000 MULT=240.3
 CO2 CONCENTRATIONS AS C1 IN  OUTLET  STARTING AT 12/09 11:08
-------------------------------------------------------------------------------

11:08    16433  16906  16811  16339  16906  16056  12372  13317  17000  16906

AVERAGE CONC = 15904 PPM AS C1 FOR  120 MINUTES
-------------------------------------------------------------------------------
```

APPENDIX E

TEMPERATURE DATA COLLECTED DURING VOC TESTING

E-1 TEMPERATURE DATA COLLECTED DURING VOC TESTING

Date	Time (Military)	Incinerator Inlet	Catalyst Inlet	Catalyst Outlet	Stack Outlet
120882	19:18		935	807	
	19:19		929	802	
	19:20		927	800	
	19:21		918	795	
	19:22		913	795	
	19:23		923	796	
	19:24		916	792	
	19:25		909	788	728
	19:26		910	791	
	19:27		908	790	
	19:28		905	790	
	19:29		902	792	
	19:30		906	791	732
	19:31		898	792	
	19:32		989	765	
	19:33		910	766	
	19:34		910	769	
	19:35		913	769	705
	19:36		913	768	
	19:37		914	788	
	19:38		913	796	
	19:39		915	797	
	19:40		910	798	726
	19:41		910	799	
	19:42		913	794	
	19:43		904	797	
	19:44		914	800	
	19:45		911	800	730
	19:46		916	797	
	19:47		912	798	
	19:48		908	799	
	19:49		908	799	
	19:50		908	801	735
	19:51		914	800	
	19:52		912	803	
	19:53		916	805	
	19:54		914	804	
	19:55		913	802	736
	19:56		910	801	
	19:57		912	804	
	19:58		908	802	
	19:59		913	803	
	20:00		913	804	734
	20:01		906	800	
	20:02		909	802	
	20:03		909	797	
	20:04		898	797	
	20:05		900	798	740
	20:06		906	797	
	20:07		907	798	
	20:08		908	798	
	20:09		909	800	
	20:10		909	801	738
	20:11		905	799	
	20:12		909	797	
	20:13		898	798	
	20:14		909	803	
	20:15		904	805	739

E-1 TEMPERATURE DATA COLLECTED DURING VOC TESTING

(Continued)

Date	Time (Military)	Incinerator Inlet	Catalyst Inlet	Catalyst Outlet	Stack Outlet
120882	20:16		908	803	
	20:17		908	803	
	20:18		902	799	
	20:19		898	800	
	20:20		900	792	732
	20:21		906	779	
	20:22		901	774	
	20:23		913	774	
	20:24		908	776	
	20:25		896	768	714
	20:26		898	760	
	20:27		908	760	
	20:28		907	779	
	20:29		912	798	
	20:30		911	796	733
	20:31		906	794	
	20:32		906	798	
	20:33		909	802	
	20:34		903	801	
	20:35	213	927	821	738
	20:36		924	822	
	20:37		922	821	
	20:38		930	820	
	20:39		928	823	
	20:40	218	932	820	736
	20:41		927	821	
	20:42		925	819	
	20:43		922	820	
	20:44		933	821	
	20:45	213	932	823	737

APPENDIX F

EPA METHOD 2 DATA

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VELOCITY PROFILE FIELD DATA

Plant Name> C-2

Sampling Location> Inlet Sample Ident.> C-2-48-2

Date 120882 (MMDDYY) Time Start 1924 (HHMM) Time Finish 1936 (HHMM)

Duct Dimensions ____ x ____ ft. or Diameter 1.54 ft.

PTCF 0.84 % H_2O ____

Bar Press. 30.0 "Hg % CO ____ % N_2 ____

Static Press. -1.14 "H_2O % CO_2 ____ % H_2 ____

Operator Initials CBC/RFE % O_2 ____ % CH. ____

Pt.	Stack Temp. °F			Velocity Pressure "H_2O			Other		
	#1	#2	Ave	#1	#2	Ave	#1	#2	Ave
T1	190	195	192	.06	.10	.08			
2	194	201	198	.14	.13	.14			
3	192	211	202	.15	.10	.12			
4	192	224	212	.12	.11	.12			
5	190	226	208	.11	.13	.12			
6	190	227	208	.11	.10	.10			
7	189	227	208	.12	.11	.12			
8	195	227	211	.10	.09	.10			
9	207	226	216	.10	.10	.10			
10	211	225	218	.09	.09	.09			
11	215	223	219	.09	.10	.10			
12	218	220	219	.09	.09	.09			
S1	190	185	188	.09	.06	.08			
2	190	190	190	.09	.09	.09			
3	189	204	196	.11	.08	.10			
4	189	210	200	.10	.09	.10			
5	190	214	202	.10	.10	.10			
6	194	217	206	.13	.13	.13			

Weather Indoors, 80°F

Remarks Inclined manometer

7	195	217	206	.16	.16	.16
8	196	216	206	.20	.17	.18
9	198	215	206	.19	.18	.18
10	200	215	208	.18	.18	.18
11	207	213	210	.18	.19	.18
12	210	210	210	.18	.19	.18

VELOCITY DETERMINATION

Input: Pitot ΔP (ΔP, in. H_2O); stack temperature (T_s, °R); wet molecular weight of gas (M_s), from gas analysis; absolute stack pressure (P_s, in. Hg); pitot tube correction factor (PTCF), usually 0.84.

Preliminary Calculations:

1) Average $\sqrt{\Delta P} = \frac{\Sigma\sqrt{\Delta P}}{N} =$ 0.347

where N is the number of points measured. For one point, just use $\sqrt{\Delta P}$.

2) Wet molecular weight (M_s) (e.g., using Orsat and EPA Method 4 data), g/g-mole

$M_s = [44(\text{Dry } \%CO_2) + 32(\text{Dry } \%O_2) + 28(\text{Dry } \%CO) + 28(\text{Dry } \%N_2)] \times (.01) \times (1-\text{Moisture Fraction}) + 18(\text{Moisture Fraction})$

$= [44 \times ____ + 32 \times ____ + 28 \times ____ + 28 \times ____] \times (.01)(1-MF) + 18(MF)$

$=$ 28 g/g-mole

3) Absolute Stack Pressure (P_s), "Hg

$P_s =$ (Barometric Pressure, "Hg) + (Stack Static Pressure, "H_2O)

$=$ (30.0)"Hg + (−1.14)"H_2O (0.07355)

$=$ 29.9 "Hg

4) Absolute Stack Temperature (T_s), °R

$T_s =$ (Stack Temperature, °F) + 460

$=$ (206)°F + 460

$=$ 666 °R

Final Calculation (average stack gas velocity, V_s, ft/sec):

$$V_s = (85.49)(PTCF)\sqrt{\frac{(T_s,\ ^\circ R)}{(M_s)(P_s,\ "Hg)}}\ (\text{Ave } \sqrt{\Delta P})$$

$$= (85.49)(.84)\sqrt{\frac{(666)}{(28)(29.9)}}\ (.347)$$

$=$ 22.2 ft/sec

A = 1.86 ft²

Q = 1,960 scfm (wet)

Date 121582 Time 1813 Signature JRB

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VELOCITY PROFILE FIELD DATA

Plant Name> C-2

Sampling Location> OUTLET Sample Ident.> C-2-49-2

Date 120882 (MMDDYY) Time Start 2004 (HHMM) Time Finish 2019 (HHMM)

Duct Dimensions ____ x ____ ft. or Diameter 1.75 ft.

PTCF 0.84 % H_2O ____

Bar Press. 30.0 "Hg % CO ____ % N_2 ____

Static Press. -0.01 "H_2O ____ % CO_2 ____ % H_2 ____

Operator Initials CBC/RFE % O_2 ____ % CH_4 ____

Pt.	Stack Temp. °F			Velocity Pressure "H_2O			Other ( )		
	#1	#2	Ave.	#1	#2	Ave.	#1	#2	Ave.
E1	704	730	717	.12	.11	.12			
2	701	740	720	.12	.13	.12			
3	700	745	722	.13	.14	.14			
4	710	744	727	.14	.14	.14			
5	716	740	728	.14	.14	.14			
6	723	737	730	.13	.13	.13			
7	726	727	726	.14	.14	.14			
8	729	728	728	.15	.16	.16			
9	729	728	728	.16	.16	.16			
10	728	722	725	.15	.15	.15			
N1	681	710	696	.13	.12	.12			
2	681	715	698	.14	.13	.14			
3	682	715	698	.14	.14	.14			
4	689	715	702	.15	.15	.15			
5	699	712	706	.15	.17	.16			
6	707	710	708	.18	.21	.20			
7	710	708	709	.23	.25	.24			
8	711	710	710	.25	.26	.26			

Weather 60°F, cloudy

Remarks Inclined manometer

9	711	705	708	.26	.25	.26
10	703	703	703	.22	.21	.22

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best available copy.

VELOCITY DETERMINATION

Input: Pitot ΔP (ΔP, in. H_2O); stack temperature (T_s, °R); wet molecular weight of gas (M_s), from gas analysis; absolute stack pressure (P_s, in. Hg); pitot tube correction factor (PTCF), usually 0.84.

Preliminary Calculations:

1) Average $\sqrt{\Delta P} = \frac{\Sigma\sqrt{\Delta P}}{N} =$ 0.402

where N is the number of points measured. For one point, just use $\sqrt{\Delta P}$.

2) Wet molecular weight (M_s) (e.g., using Orsat and EPA Method 4 data), g/g-mole

$M_s = [44(\text{Dry } \%CO_2) + 32(\text{Dry } \%O_2) + 28(\text{Dry } \%CO) + 28(\text{Dry } \%N_2)] \times (.01)$
$\times (1-\text{Moisture Fraction}) + 18(\text{Moisture Fraction})$
$= [44 \times ____ + 32 \times ____ + 28 \times ____ + 28 \times ____] \times (.01)(1-MF) + 18(MF)$
$=$ 28 g/g-mole

3) Absolute Stack Pressure (P_s), "Hg

$P_s =$ (Barometric Pressure, "Hg) + (Stack Static Pressure, "H_2O)
$= (\ 30.0\ )$"Hg + $(\ -.01\ )$"H_2O (0.07355)
$=$ 30.0 "Hg

4) Absolute Stack Temperature (T_s), °R

$T_s =$ (Stack Temperature, °F) + 460
$= (\ 714\ )$°F + 460
$=$ 1174 °R

Final Calculation (average stack gas velocity, V_s, ft/sec):

$$V_s = (85.49)(PTCF)\sqrt{\frac{(T_s,\ °R)}{(M_s)(P_s,\ "Hg)}}\ (\text{Ave } \sqrt{\Delta P})$$

$$= (85.49)(.84)\sqrt{\frac{(1174)}{(28)(30.0)}}\ (.402)$$

$=$ 34.1 ft/sec

$A = 2.41\ ft^2$

$Q = 2,220$ scfm (wet)

Date 121582 Time 1825 Signature JRB

APPENDIX G

EPA METHOD 3 (EQUIVALENT) DATA

TABLE H-1. INCINERATOR C-2 FIXED GAS DATA

Date	Time	% CO_2	% O_2	% N_2	Dry MW	Notes
120882	18:20	0.02	21.95	78.03	28.9	Inlet, Press OFF
	18:26	0.01	22.12	77.87	28.9	Inlet, Press OFF
	18:39	1.39	19.67	78.94	29.0	Outlet, Press OFF
	18:44	1.33	19.57	79.11	29.0	Outlet, Press OFF